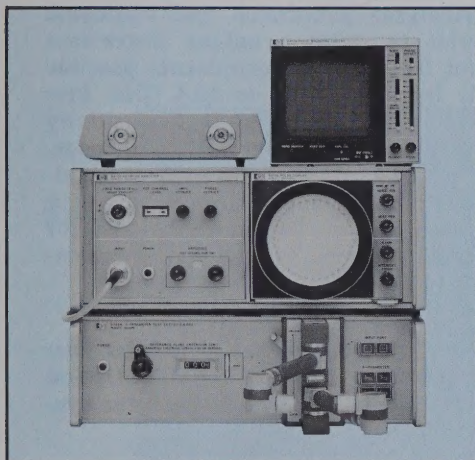


NETWORK ANALYZER

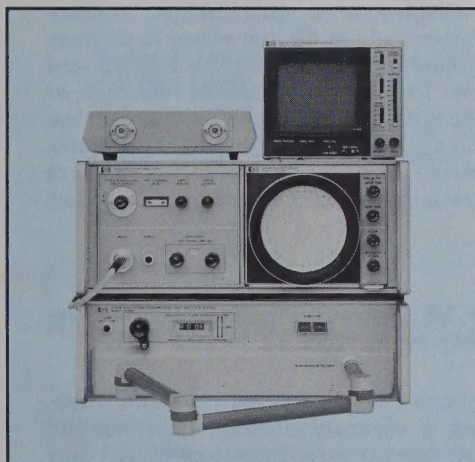
models

8410S OPTIONS 100, 110, 200, 210,
300, 310
8410A, 8411A, 8412A, 8413A, 8414A,
8418A, 8717A, 8740A, 8741A, 8742A,
8743A, 8745A, 8747A, 11587A,
11600B, 11602B, 11604A, 11605A,
11607A, 11650A

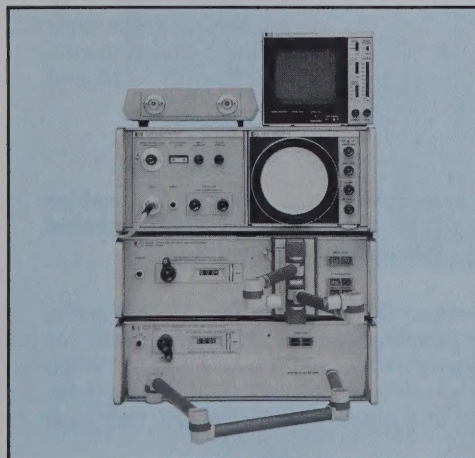
TECHNICAL DATA 15 JUN 70



0.11 - 2 GHz
8410S OPTION 110



2 - 12.4 GHz
8410S OPTION 210



0.11 - 12.4 GHz
8410S OPTION 310

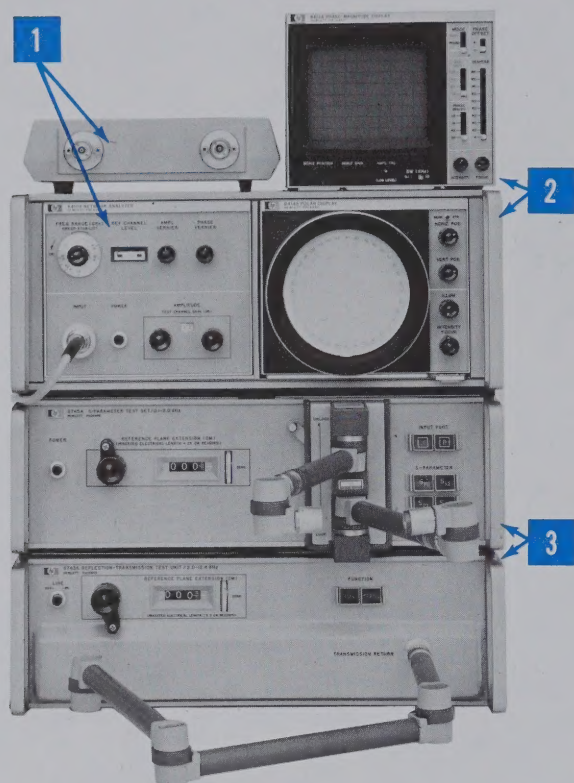
COMPLETE MICROWAVE MEASUREMENT SYSTEMS

- System Accuracy Fully Specified
- Pushbutton Operation

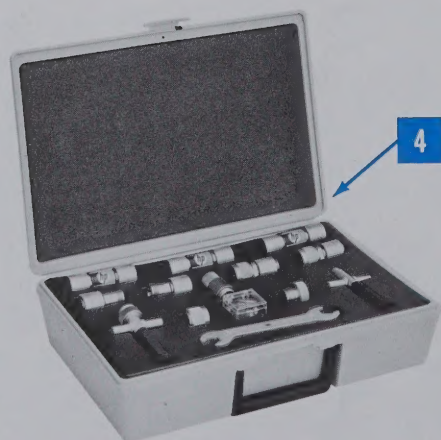
measure all network parameters

- PHASE
 - GAIN
 - ATTENUATION
 - IMPEDANCE
 - RETURN LOSS
 - REFLECTION COEFFICIENT
 - S-PARAMETERS
-
- Swept-Frequency Measurements Over Octave Bands
 - 60 dB Dynamic Range
 - Easy Connections to Test Device
 - Transistor Characterization

8410S NETWORK ANALYZER SYSTEM



8410S OPTION 310
0.11 - 12.4 GHz



1

The Network Analyzer Mainframe and Harmonic Frequency Converter make possible broad band frequency conversion.

The Network Analyzer Mainframe and Harmonic Frequency Converter comprise a unique instrument which makes swept frequency measurements possible over octave bands from 110 MHz to 12.4 GHz. Frequency conversion from RF to IF gives high sensitivity and greater than 60 dB of dynamic measurement range. 69 dB of IF gain control calibrated in 1 dB steps allows accurate gain or insertion loss measurements with IF substitution. Internal leveling eliminates the need for a leveled sweep oscillator. See page 10 for specifications.

2

Phase-Magnitude Display and Polar Display provided with each 8410S Option 110, 210, and 310 Network Analyzer System.

The readout plug-ins display magnitude and phase relationships in rectangular or polar coordinates. The Phase-Magnitude Display is a dual-channel oscilloscope. It displays magnitude in dB and phase in degrees versus frequency allowing resolution up to 0.05 dB and 0.2 degree. The Polar Display Unit displays reflection or transmission coefficients directly in polar coordinates. Smith Chart overlays give direct readout of impedance. Both displays provide analog outputs for permanent X-Y recordings. See pages 11 and 12 for specifications.

3

Two RF transducer units cover the frequency range from 0.1 to 12.4 GHz.

The transducer units contain RF switches and directional couplers used to separate incident, reflected, and transmitted signals. Also included is a calibrated line stretcher for extending the measurement reference plane. Coax rotary joints and airlines mounted on the front of the transducer units allow easy connections to the test device. With just one simple setup and calibration both transmission and reflection measurements are easily made by pushing a button. See pages 13 and 14 for specifications.

4

All accessories and interconnect cables needed for measurements are provided with systems.

HP 11650A Accessory Kit includes low VSWR pads, Type N to APC-7 adapters, and calibration shorts for precision measurements. All necessary RF and video cables for system setup are also supplied, along with simplified checkout and operating procedures. See page 12 for specifications.

APPLICATIONS

ATTENUATION MEASUREMENTS

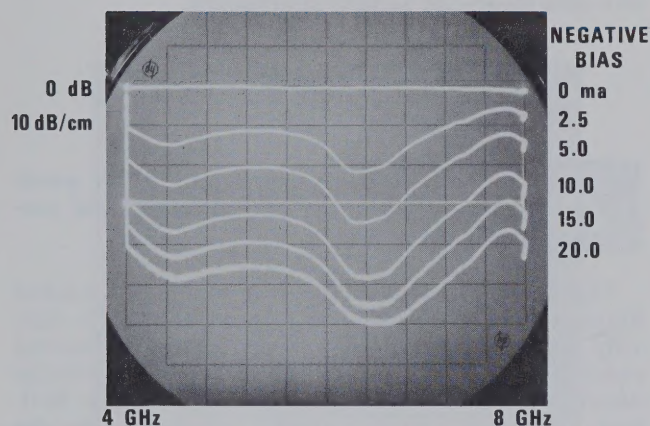


Figure 1. Pin Modulator Attenuation vs. Frequency and Bias Level: Multiple exposure photo for various bias conditions shows attenuation nonlinearity as a function of frequency and/or bias level. Phase characteristics can be observed in a similar manner.

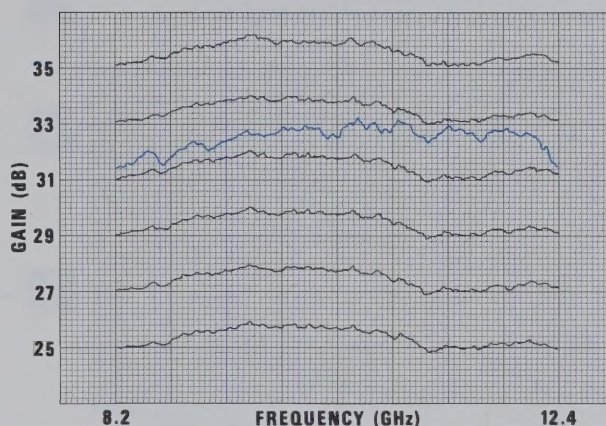


Figure 2. TWT Gain: High resolution X-Y recording, plotting of the gain of a TWT amplifier swept-tested between 8.2 and 12.4 GHz. The frequency response of the system has been eliminated by plotting grid lines.

REFLECTION/IMPEDANCE MEASUREMENTS

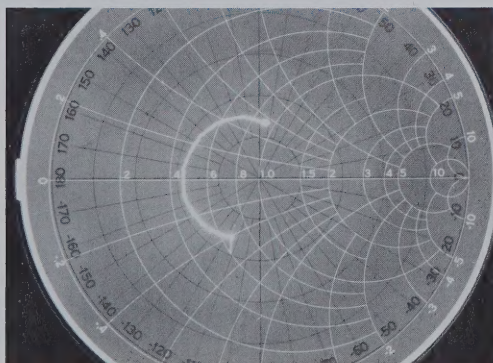


Figure 3. Microcircuit Amplifier Input Impedance: Swept display of input reflection of a microcircuit amplifier between 1 GHz and 2 GHz. The Smith Chart overlay allows direct readout of impedance over the frequency range being swept.

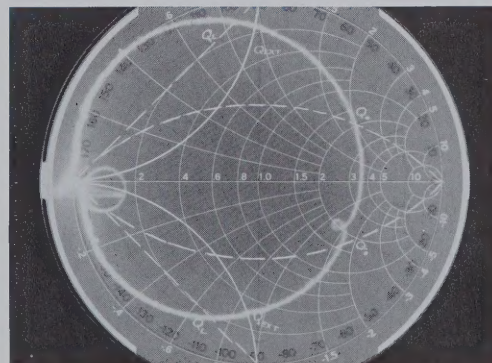
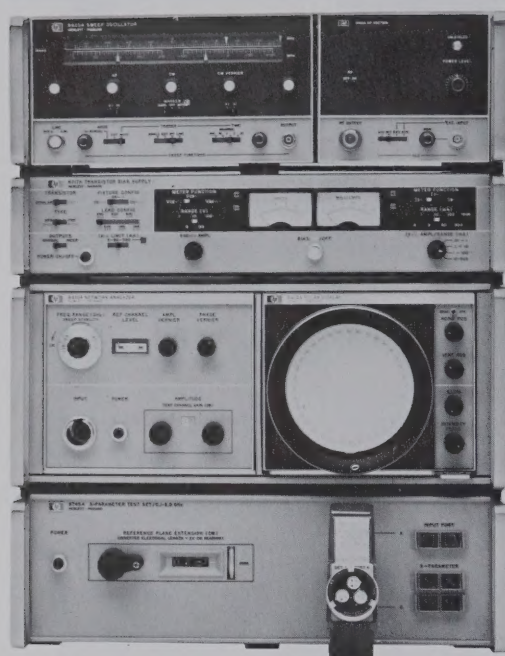


Figure 4. Response of a Magnetically Tuned YIG Sphere at $f_0 = 10$ GHz. Δf sweep is 450 MHz. The loops, just below the real axis and the second at the end of the trace at the left, are parasitic modes. The specially scribed Smith Chart overlay allows one to determine the Q of such devices rapidly.

S-PARAMETER MEASUREMENT SYSTEM



1

The RF Sweep Oscillator Source.

The Hewlett-Packard Sweep Oscillators are designed to provide optimal performance of the Network Analyzer Transistor Measurement System. See the respective data sheets for further information.

1

2

2

The Transistor Bias Supply makes possible rapid and accurate voltage and current bias settings.

The Bias Supply is a companion unit to the Transistor Fixtures. It is an accurate, stable, manual and/or digitally programmable transistor bias supply. It features switching for convenience in test setups and provides metering for accurate voltage/current settings and readings. Front panel switches quickly establish stable bias conditions for all transistor configurations used in the transistor fixtures. See pages 17 and 18 for specifications.

3

4

3

The Network Analyzer Mainframe, Harmonic Frequency Converter, and Polar Display serve as the central core of this measuring system.

The Network Analyzer Mainframe, Harmonic Frequency Converter, and Polar Display convert data from the transistor under test to a polar display for reflection or transmission coefficients. Smith Chart overlays give direct readout of input and output impedances. See page 10 for specifications.

4

The Transducer and Transistor Fixture make possible transistor or other semiconductor characterization over the frequency range from 0.11 to 2.0 GHz.

The Transducer front panel pushbuttons automatically set up the measuring circuits for each transistor s parameter. The Transistor Fixtures are for TO-18/TO-72 and TO-5/TO-12 base configurations. They provide common emitter-base-collector and common source-gate-drain connections for bipolar and FET transistors. See pages 14 and 16 for specifications.

This system saves time characterizing transistors and other devices. After one quick setup and calibration, the two-port s parameters can be measured with push-button ease. No time is spent altering coax circuits or precisely tuning instruments. If you need h, y, or z parameters, they can be readily calculated.

Switches quickly establish the circuits for common emitter-base-collector and common source-gate-drain for NPN, PNP and N-channel, P-channel transistors. If a transistor is tested in one configuration and then switched to another, exactly the same bias conditions are preserved. In fact, if another transistor is plugged into the test setup, it will have the same bias conditions as the first.

Transistors are biased via the built-in biasing networks. The unit is completely programmable, and can be used for automatic testing. Biasing and remote s parameter selection are done through a single, rear panel cable connector.

APPLICATIONS

S-PARAMETER MEASUREMENTS



Figure 5. S_{21} of a Transistor. Transistor in common emitter configuration measured from 250 MHz to 500 MHz. The system has been calibrated for a full-scale voltage gain = 5. Transistor gain is 2 at 500 MHz and increases to 3.2 at 250 MHz.

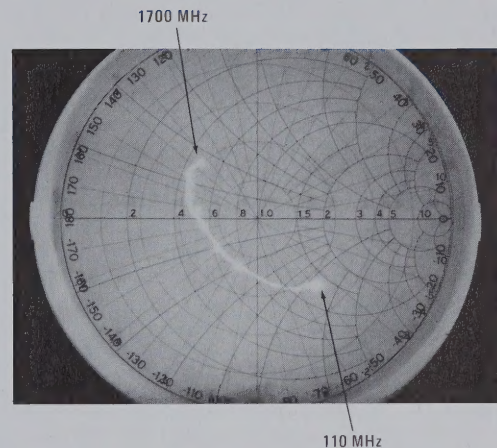


Figure 6. S_{11} of a Transistor. Transistor in common emitter configuration measured from 110 MHz to 1.7 GHz, with Smith Chart overlay, transistor input impedance can be read directly. Over the frequency range tested, the impedance changes from $70 - j60$ ohms to $22.5 + j15$ ohms.



Figure 7. Negative Impedance. Output impedance from 115 MHz to 560 MHz of a G.E. 1N3716 tunnel diode biased at 200 mV and 2.5 mA. The compressed Smith Chart overlay allows direct readout of negative impedance. An expanded Smith Chart overlay is also supplied for measuring impedances near 50 ohms with high resolution.

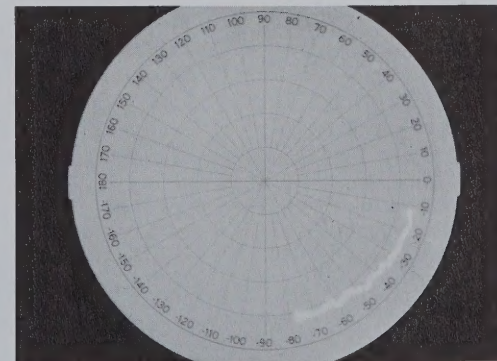


Figure 8. S_{22} of a Transistor. Transistor in common emitter configuration measured from 110 MHz to 2 GHz. The system has been calibrated for a full-scale reflection coefficient = 1.0. As can be predicted for a common emitter setup, the output reflection is high corresponding to a high output impedance.

8410 SYSTEM SPECIFICATIONS

Specifications Common to 8410S Options 110, 210, 310

DESCRIPTION

Function: All systems measure transmission and reflection parameters on a swept-frequency or CW basis with readout of attenuation, gain, phase shift, reflection coefficient, return loss, impedance, depending on display unit.

DISPLAY UNITS

8412A Phase-Magnitude Display: Rectangular Coordinate dual-channel CRT.

Amplitude Range: 80 dB.

Phase Range: $\pm 180^\circ$.

Resolution:

Selectable Amplitude: 10, 2.5, 1, 0.25 dB/division. Allows measurement resolution up to 0.05 dB.

Selectable Phase: 90, 45, 10, 1 degree/division. Allows measurement resolution up to 0.2° .

Marking and Blanking: Accepts marker signals and blanking pulses from HP Sweep Oscillators.

8414A Polar Display: Polar Coordinate CRT with magnitude calibration divisions at 20, 40, 60, 80, and 100% of full scale. Outer range settable by IF gain control and amplitude vernier.

Marking and Blanking: Accepts -5 V peak marker signals, which appear as intensified dot on CRT face, and blanking pulses from HP Sweep Oscillators.

CONNECTORS

RF Input, Type N female stainless steel; Measurement Ports, APC-7 precision 7-mm connectors.

PERFORMANCE

TRANSMISSION MEASUREMENT (using 8412A):

Accuracy curves show overall system uncertainty when measuring amplitude and phase. Sources of error included are IF gain control, display accuracy, phase offset, system noise and cross-talk. System frequency response is specified separately and is not included in accuracy curves.

Amplitude Accuracy (60-dB dynamic range):

IF Gain Control:

69 dB in 10-dB and 1-dB steps.

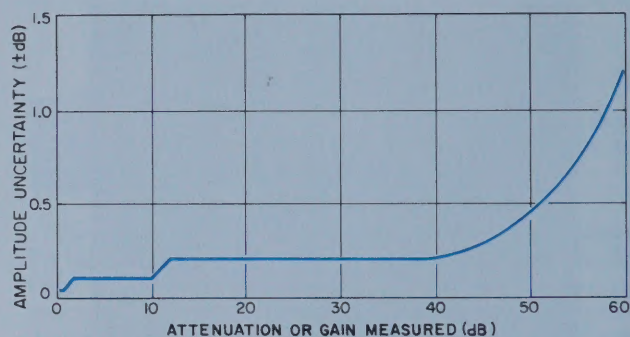
± 0.1 dB/10 dB } ± 0.2 dB maximum
 ± 0.05 dB/1 dB } cumulative

Display:

0.08 dB/dB from midscreen.

Rear Output: 0.03 dB/dB overall variation from 0 V output; 0.01 dB/dB variation for variations within $+30$ dB to -10 dB from 0 V output.

Temperature Coefficient: Typically <0.05 dB/ $^\circ\text{C}$ at midscreen.



Amplitude uncertainty for transmission measurements as a function of amplitude measured.

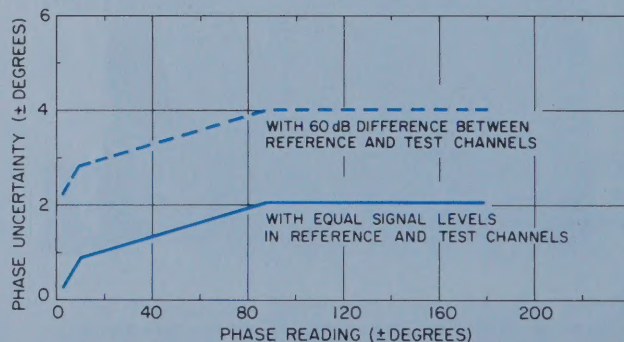
Phase Accuracy:

Phase Offset: $0.3^\circ/20^\circ$ step; maximum 3° for 360° change.

Display: $0.065^\circ/\text{degree}$ from midscreen.

Rear Output: $0.015^\circ/\text{degree}$ variation from 0 V output.

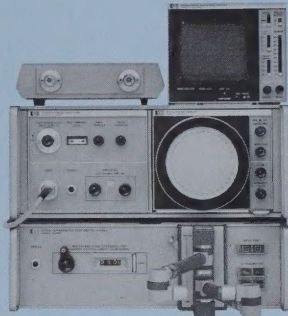
Temperature Coefficient: Typically $0.1^\circ/\text{C}$.



Phase uncertainty for transmission measurements as a function of phase shift measured.

8410S OPTION 110 SYSTEM SPECIFICATIONS

MODEL 8410S OPTION 110



8410A Network Analyzer
 8411A Harmonic Frequency Converter
 8412A Phase-Magnitude Display
 8414A Polar Display Unit
 8745A S-Parameter Test Set
 11599A Quick Connect Adapter
 11604A Universal Extension
 11650A Accessory Kit
 Cables for System Connection
 Price: \$12,420.00

GENERAL

Frequency Range: 0.11 to 2.0 GHz.

Transmission-Reflection Selection: Manual by front panel, lighted pushbuttons; remote by contact closure or saturated transistors through 36-pin connector contacts. Short circuit current, 12 mA; open circuit voltage, 12 V dc.

RF Input: 20-dB range between -21 dBm and +7 dBm. 20-dB variation causes less than 1.5 dB and 4° change in amplitude and phase readings.

Source Reflection Coefficient:¹
 ≤ 0.09 (≤ 1.2 SWR), 0.11 - 2.0 GHz.

Termination Reflection Coefficient:²
 ≤ 0.11 (< 1.25 SWR), 100 - 200 MHz
 ≤ 0.09 (< 1.20 SWR), 200 - 2000 MHz

Directivity:
 > 36 dB (typically > 39 dB) 0.11 - 1.0 GHz
 > 32 dB (typically > 36 dB) 1.0 - 2.0 GHz

Insertion Loss, RF Input to Test Port: 4 dB nominal.

Frequency Response:

Transmission: Typically $< \pm 0.35$ dB amplitude and $< \pm 3^\circ$ phase.

Reflection: Typically $< \pm 0.06$ magnitude and $\pm 5^\circ$ phase as read on the 8414A polar display with a short on the test port.

Transmission Measurement Accuracy
 (See common performance specifications)

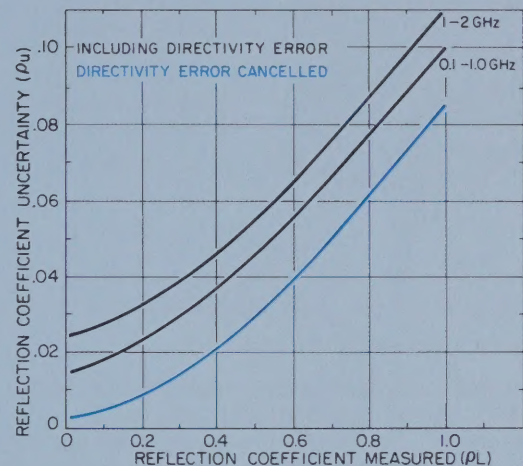
Reflection Measurement Accuracy: (Using 8414A)
 Accuracy curves show overall system uncertainty when measuring reflection coefficient. Sources of error included are directivity, source match, and

polar display accuracy. System frequency response is specified separately and is not included in the accuracy curves.

Magnitude Accuracy:

$$\rho_u = \pm(0.015 + 0.03 \rho_L + 0.06 \rho_L^2) \quad 0.11 - 1.0 \text{ GHz}$$

$$\rho_u = \pm(0.025 + 0.03 \rho_L + 0.06 \rho_L^2) \quad 1.0 - 2.0 \text{ GHz}$$



Reflection coefficient magnitude uncertainty including coupler directivity and when directivity is cancelled using a low VSWR load.

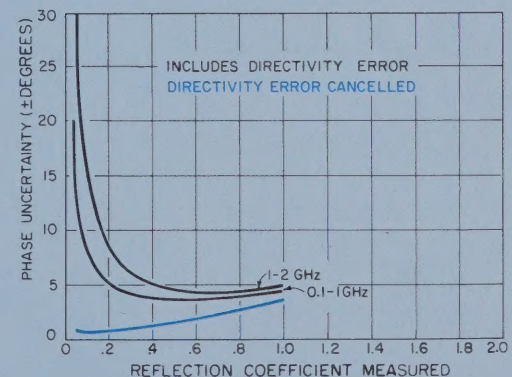
Phase Accuracy:

$$\phi_u = \sin^{-1} \frac{\rho_u}{\rho_L} \quad \text{for } \phi_u < 90^\circ$$

ϕ_u = phase uncertainty

ρ_u = magnitude uncertainty

ρ_L = measured reflection coefficient magnitude



Phase uncertainty including coupler directivity and when directivity is cancelled using a low VSWR load.

¹ Source Reflection Coefficient: Reflection coefficient of the port used to supply incident signal to the device under test.

² Termination Reflection Coefficient: Reflection coefficient of port connected to output of test device when transmission or reflection measurement is being made.

8410S OPTION 210 SYSTEM SPECIFICATIONS

MODEL 8410S OPTION 210



- 8410A Network Analyzer
 - 8411A Harmonic Frequency Converter
 - 8412A Phase-Magnitude Display
 - 8414A Polar Display Unit
 - 8743A Reflection/Transmission Test Unit
 - 11605A Flexible Arm
 - 11650A Accessory Kit
 - Cables for System Connection
- Price: \$11,580.00**

GENERAL

Frequency Range: 2.0 to 12.4 GHz.

Transmission-Reflection Selection: Manual, by front-panel, lighted pushbuttons; remote, by contact closure or saturated transistors through 36-pin connector contacts. Short circuit current, 12 mA; open circuit voltage, 12 V dc.

RF Input: 20-dB range between -14 dBm and +14 dBm. 20-dB variation causes less than 1.5 dB and 4° change in amplitude and phase readings.

Source Reflection Coefficient:¹

- ≤ 0.09 (1.2 SWR), 2 - 8 GHz
- ≤ 0.13 (1.3 SWR), 8 - 12.4 GHz

Termination Reflection Coefficient:²

- ≤ 0.09 (1.2 SWR), 2 - 8 GHz
- ≤ 0.13 (1.3 SWR), 8 - 12.4 GHz

Directivity: ≥ 30 dB, 2 - 12.4 GHz.

Insertion Loss, RF Input to Test Port: 20 dB nominal.

Frequency Response:

Transmission: Typically < ±0.5 dB amplitude and < ±5° phase.

Reflection: Typically < ±0.06 magnitude and < ±7° phase, as read on the 8414A with a short on the unknown port.

Transmission Measurement Accuracy

(See common performance specifications)

Reflection Measurement Accuracy:

Accuracy curves show overall system uncertainty when measuring reflection coefficient. Sources of

error included are directivity, source match, and polar display accuracy. System frequency response is specified separately and is not included in the accuracy curves.

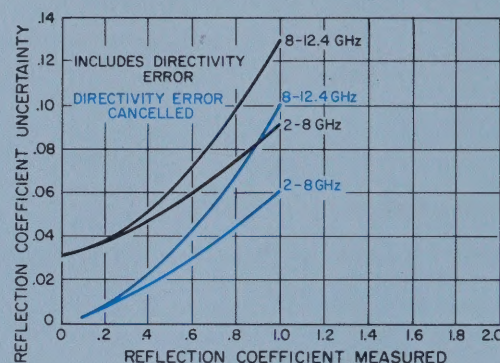
Magnitude Accuracy:

$$\rho_u = \pm(0.032 + 0.03 \rho_L + 0.03 \rho_L^2) \quad 2 - 8 \text{ GHz}$$

$$\rho_u = \pm(0.032 + 0.04 \rho_L + 0.06 \rho_L^2) \quad 8 - 12.4 \text{ GHz}$$

ρ_u = magnitude uncertainty

ρ_L = measured reflection coefficient magnitude

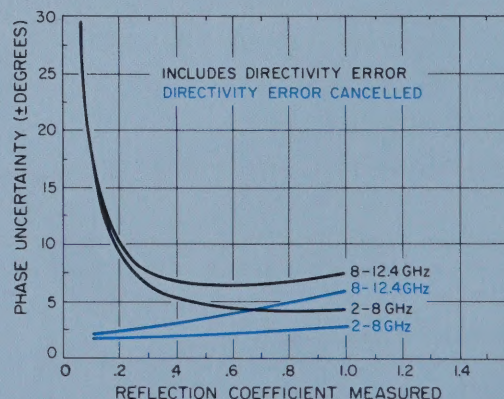


Reflection coefficient uncertainty including coupler directivity and when directivity is cancelled using a sliding load.

Phase Accuracy:

$$\phi_u = \sin^{-1} \frac{\rho_u}{\rho_L} \quad \text{for } \phi_u < \pm 90^\circ$$

ϕ_u = phase uncertainty



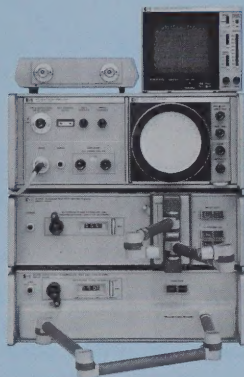
Phase uncertainty including coupler directivity and when directivity is cancelled using a sliding load.

¹ Source Reflection Coefficient: Reflection coefficient of the port used to supply incident signal to the device under test.

² Termination Reflection Coefficient: Reflection coefficient of port connected to output of test device when transmission or reflection measurement is being made.

8410S OPTION 310 SYSTEM SPECIFICATIONS

MODEL 8410S OPTION 310

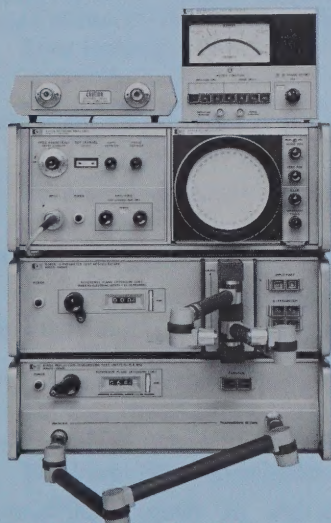


8410A Network Analyzer
 8411A Harmonic Frequency Converter
 8412A Phase-Magnitude Display
 8414A Polar Display Unit
 8743A Reflection/Transmission Test Unit
 8745A S-Parameter Test Set
 11599A Quick Connect Adapter
 11604A Universal Extension
 11605A Flexible Arm
 11650A Accessory Kit
 Cables for System Connection
 Price: \$15,670.00

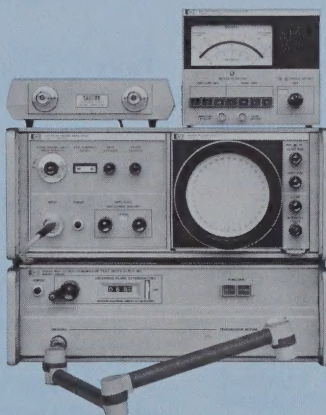
Frequency Range: 0.11 to 12.4 GHz.

Specifications for Model 8410S Option 310 are a combination of Models 8410S Option 110 and 8410S Option 210. All specifications for those models pertain directly to the 8410S Option 310 at the frequencies of interest.

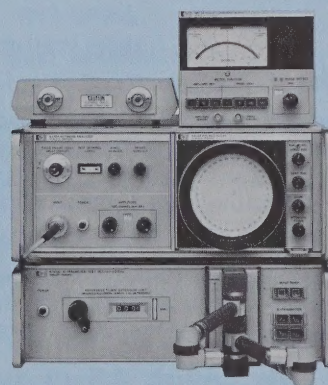
OTHER AVAILABLE OPTIONS



0.11 - 2 GHz
 8410S Option 100
 Price: \$11,995.00



2 - 12.4 GHz
 8410S Option 200
 Price: \$11,115.00



0.11 - 12.4 GHz
 8410S Option 300
 Price: \$15,245.00

In these options, the 8413A Phase-Gain Indicator is substituted for the 8412A Phase-Magnitude Display.

The Phase-Gain Indicator displays on a meter magnitude in dB and phase in degrees. Resolution is better than 0.1 dB and 0.1 degree. Calibrated analog outputs allow swept display of both phase and magnitude simultaneously on an oscilloscope or X-Y recorder.

INDIVIDUAL INSTRUMENT SPECIFICATIONS

NETWORK ANALYZER MAINFRAME—HARMONIC FREQUENCY CONVERTER

8410A NETWORK ANALYZER



8411A HARMONIC FREQUENCY CONVERTER



Function: 8411A Harmonic Frequency Converter converts RF signals to IF signals for processing in 8410A mainframe. 8410A is the mainframe for display plug-in units. Mainframe includes tuning circuits, IF amplifiers, and precision IF attenuator.

Frequency Range: 0.11 to 12.4 GHz.

8411A Input Impedance: 50 ohms nominal. SWR <1.5 to 8 GHz; <2.0 to 12.4 GHz; connectors precision 7 mm coax (APC-7).

Channel Isolation: >65 dB, 0.1 to 6 GHz; >60 dB, to 12.4 GHz.

AMPLITUDE

Amplitude Range:

Reference Channel: 20-dB range between -16 and -44 dBm; meter indicates proper range. 20 dB variation causes less than 1.5 dB and 4° change in amplitude and phase readings.

Test Channel: -10 to -78 dBm.

Maximum RF Input to Either Channel: 50 mW (+17 dBm) damage level.

Maximum dc on RF Line: +3 V (damage level).

IF Gain Control: Adjusts gain of test channel relative to reference channel.

Range: 69 dB total in 10-dB and 1-dB steps; vernier provides continuous adjustment over at least 2 dB.

Accuracy: ± 0.1 dB per 10-dB step, ± 0.05 dB per 1-dB step. Maximum cumulative, ± 0.2 dB.

Frequency Response: Reference and test channels typically track within:
 ± 0.3 dB for any octave 0.11 - 8 GHz.
 ± 0.4 dB 8 - 12.4 GHz.

Noise: Less than -78 dBm equivalent input noise.

PHASE

Phase Range: 0 to 360°.

Control: Vernier provides continuous phase reference adjustment over at least 90°.

Frequency Response: Reference and test channels typically track within:
 ± 1 dB for any octave 0.11 - 8 GHz.
 ± 2 dB 8 - 12.4 GHz.

GENERAL

Outputs: Two rear panel auxiliary outputs provide 278-kHz IF signals; outputs may be used for signal analysis, special applications, and convenient test points; modulation band-width nominally 10 kHz.

Reference Channel IF: 2 volts peak-to-peak.

Test Channel IF: 10 volts peak-to-peak or less, depending on signal level and test channel gain setting.

Power: 115 or 230 V ac $\pm 10\%$, 50 to 60 Hz, 70 watts (includes 8411A).

Weight:

8410A: Net, 34 lb (15,2 kg). Shipping, 53 lb (23,6 kg).

8411A: Net, 6¼ lb (2,8 kg). Shipping, 9 lb (4,1 kg).

Dimensions:

8410A: 7 in. high, 8¾ in. deep, 16¾ in. wide (17,8 x 21,3 x 42,5 cm).

8411A: 2½ in. high, 5½ in. deep, 9 in. wide (6,8 x 14,3 x 22,9 cm), exclusive of connectors. 5-ft cable permanently attached for connection to 8410A.

Price:

Model 8410A, \$2,100.00.

Option 005: (Compatible with 8418A) add \$100.00.

Model 8411A, \$2,600.00.

INDIVIDUAL INSTRUMENT SPECIFICATIONS

DISPLAY UNITS

8412A PHASE-MAGNITUDE DISPLAY



Function: Plug-in CRT display unit for 8410A. Displays relative amplitude in dB and/or relative phase in degrees between reference and test channel inputs versus frequency.

AMPLITUDE

Range: 80 dB display range with selectable resolutions of 10, 2.5, 1, and 0.25 dB/division.

Accuracy:

Display: 0.08 dB/dB from midscreen.

Rear Output: 0.03 dB/dB overall variation from 0 volt output; 0.01 dB/dB variation for variations within +30 dB to -10 dB from 0 V output.

Temperature Coefficient: Typically 0.05 dB/°C at midscreen.

PHASE

Range: $\pm 180^\circ$ display range with selectable resolutions of 90, 45, 10, and 1° /division.

Accuracy:

Display: 0.065° /degree from midscreen.

Rear Output: 0.015° /degree variation from 0 volt output.

Phase Offset: $0.3^\circ/20^\circ$ step, not to exceed total error of 3° for 360° of change, positive or negative direction.

Vs. Displayed Amplitude: $1^\circ/10$ dB, 4° total error for 80 dB.

Temperature Coefficient: Typically $0.1^\circ/\text{C}$.

GENERAL

Inputs:

Sweep: Requires sweep signal (5 V p-p min.) from sweep oscillator for horizontal sweep drive.

Marker: (Rear panel) z-axis intensifies traces with -5 V dc and blanks with +5 V dc applied.

Blanking: (Rear panel) Blanks CRT with -4 V dc applied.

Outputs:

Amplitude: 50 mV/dB.

Phase: 10 mV/degree.

Display Filter: 100 Hz, 10 kHz video filter. Switch located below CRT.

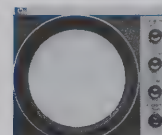
Power: 23 watts supplied by mainframe.

Weight: Net, 17 lb (7,8 kg). Shipping, 22 lb (10 kg).

Dimensions: 6 in. high, $15\frac{5}{16}$ in. deep, $7\frac{7}{32}$ in. wide. (15,2 x 39,5 x 18,6 cm), excluding front panel knobs.

Price: Model 8412A, \$1,575.00.

8414A POLAR DISPLAY



Function: Plug-in CRT display unit for 8410A.

Displays amplitude and phase data in polar coordinates on 5-in. cathode ray tube.

Range: Normalized polar coordinate display; magnitude calibration 20% of full scale per division. Scale factor is a function of IF setting on 8410A. Phase calibrated in 10-degree increments over 360-degree range.

Accuracy: Error circle on CRT < 3 mm.

Outputs: Two dc outputs provide horizontal and vertical components of polar quantity. For full scale deflection, output is nominally ± 2.5 volts, $< 100 \Omega$ source impedance, minimum bandwidth (3 dB) 10 kHz.

Beam Center: Pressing BEAM CTR simulates zero-signal input. Allows convenient beam position adjustment for reference.

GENERAL

CRT: 5-inch, 5-kV post accelerator tube with P-2 phosphor; internal polar graticule.

Marker Input (Rear Panel): Accepts frequency marker output pulse from HP 8690-series and 8620-series Sweep Oscillators, -5 volts peak. Markers displayed for duration of marker pulse on CRT display.

Blanking Input (Rear Panel): Accepts -4-volt RF blanking pulse from HP 8690-series and 690-series Sweep Oscillators to blank retrace during swept operation.

Background Illumination: Controls intensity of CRT background illumination for photography. Eliminates need for ultraviolet light source in oscilloscope camera when photographing internal graticule.

Drift: CRT, $< \pm 0.2$ mm/°C; auxiliary outputs, $< \pm 10$ mV/°C.

Power: Additional 35 watts supplied by 8410A.

Weight: Net, 13 lb (5,8 kg). Shipping, 18 lb (8,1 kg).

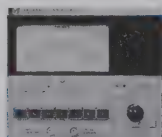
Dimensions: 6 in. high, $15\frac{5}{16}$ in. deep, $7\frac{7}{32}$ in. wide. (15,2 x 39,5 x 18,6 cm), excluding front panel knobs.

Price: Model 8414A, \$1,300.00.

INDIVIDUAL INSTRUMENT SPECIFICATIONS

DISPLAY UNITS

8413A PHASE-GAIN INDICATOR



Function: Plug-in meter display unit for 8410A. Displays relative amplitude in dB between reference and test channel inputs or relative phase in degrees. Pushbutton selection of meter function and range.

AMPLITUDE

Range: ± 30 , ± 10 , and ± 3 dB full scale.

Accuracy: $\pm 3\%$ of end scale.

Log Output: 50 millivolts per dB up to 60 dB total; 10-kHz nominal bandwidth depending on signal level; source impedance 1 k Ω ; accuracy same as meter.

Linear Output (Rear Panel): 0 to 1 V nominal at ± 30 dB meter indication; 10-kHz bandwidth; 250 Ω source impedance.

PHASE

Ranges: ± 180 , ± 60 , ± 18 , ± 6 degrees full scale.

Accuracy: $\pm 2\%$ of end scale.

Output: 10 millivolts per degree; 10-kHz bandwidth; 1 k Ω source impedance. Accuracy $\pm 2\%$ of reading on auxiliary display or ± 1 mV, whichever is greater.

Phase Offset: ± 180 degrees in 10-degree steps.

Accuracy: $\pm(0.2^\circ + 0.3^\circ/10^\circ \text{ step})$, does not exceed 2° cumulative. Referenced from 0 degrees.

Phase Response Versus Signal Amplitude: 2 degrees maximum phase change for 60-dB amplitude change in test channel.

GENERAL

Drift:

Amplitude:

Log: $< \pm 0.1$ dB/ $^\circ$ C.

Linear: $< \pm 5$ mV/ $^\circ$ C.

Phase: $< \pm 0.2^\circ$ / $^\circ$ C.

Power: Additional 15 watts supplied by 8410A.

Weight: Net, 11 lb (4,9 kg). Shipping, 15 lb (6,7 kg).

Dimensions: 6 in. high, $15\frac{5}{16}$ in. deep, $7\frac{7}{32}$ in. wide (15,2 x 39,5 x 18,6 cm), excluding front panel knobs.

Price: Model 8413A, \$1,150.00.

ACCESSORY KITS

11587A ACCESSORY KIT



Function: Accessories normally used for transmission and reflection tests with the 8740A, 8741A, and 8742A.

Kit Includes:	Qty.	Model No.	Description
	1	11566A	10-cm air line
	1	11567A	20-cm air line
	2	11524A	APC-7 to Type N female adapters
	2	11525A	APC-7 to Type N male adapters
	2	8492A Opt 010	10-dB coax attenuator
	1	8492A Opt 030	30-dB coax attenuator
	1	11511A	Type N female short
	1	11512A	Type N male short

Weight: Net, 3 lb (1,34 kg). Shipping, 5 lb (2,23 kg).

Price: \$875.00 (including storage case).

11650A ACCESSORY KIT



Function: Accessories normally used for transmission and reflection tests with the 8745A and 8743A.

Kit Includes:	Qty.	Model No.	Description
	2	11524A	APC-7 to Type N female adapter
	2	11525A	APC-7 to Type N male adapter
	1	8492A Opt 003	3-dB attenuator
	1	8492A Opt 010	10-dB attenuator
	1	8492A Opt 020	20-dB attenuator
	1	11511A	Type N female short
	1	11512A	Type N male short
	1	11565A	APC-7 short

Weight: Net, 3 lb (1,34 kg). Shipping, 5 lb (2,23 kg).

Price: \$700.00 (including storage case).

INDIVIDUAL INSTRUMENT SPECIFICATIONS

TRANSDUCER UNITS

**8743A
REFLECTION/
TRANSMISSION
TEST UNIT**



Function: Wideband RF power splitter and reflectometer with calibrated line stretcher. Pushbutton operated for either transmission or reflection measurements with Network Analyzer.

Frequency Range: 2 - 12.4 GHz.

Impedance: 50 ohms nominal.

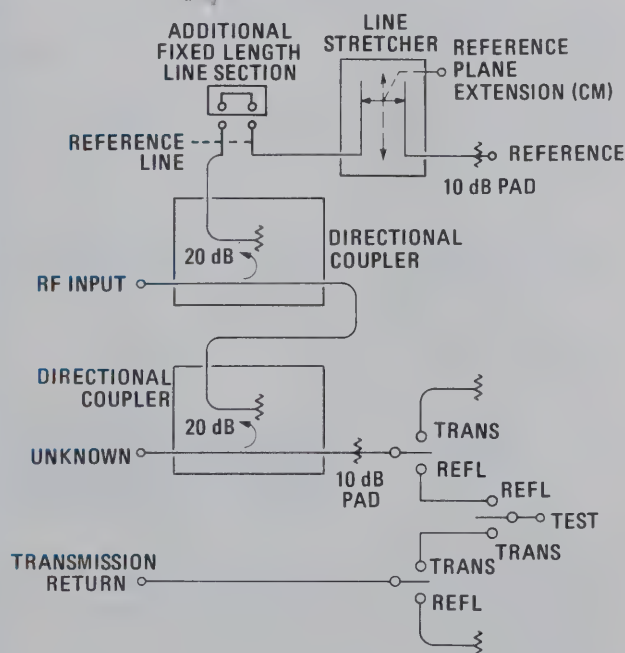
Reflection Coefficient:

Unknown Port:¹ 2-8 GHz, ≤ 0.09 (SWR 1.2); 8-12.4 GHz, ≤ 0.13 (SWR 1.30).

Transmission Return Port:² 2-12.4 GHz, ≤ 0.167
(SWR ≤ 1.4).

Directivity: 2 - 12.4 GHz, ≥ 30 dB.

Frequency Response: (Including 8411A Frequency Converter.)



8743A RF Schematic

¹ Equivalent source reflection coefficient when used with Network Analyzer.

² Reflection coefficient of port that connects to the 11605A flexible arm.

Transmission: Typically $< \pm 0.5$ dB amplitude,
 $< \pm 5^\circ$ phase.

Reflection: Typically $< \pm 0.1$ magnitude, $\pm 5^\circ$ phase as read on 8414A Polar Display with a short on the unknown port.

Insertion Loss:

From RF Input to Test Device: 20 dB nominal.

From RF Input to Reference Channel Output: 30 dB nominal.

Maximum RF Power: 2 watts.

Reference Plane Extension: 0 to 15 cm for reflection; 0 to 30 cm for transmission; calibrated by digital dial indicator. Indicator is adjustable for initial calibration.

Connectors: RF Input, Type N female, stainless steel;
all other connectors APC-7.

Remote Programming: Remote reflection or transmission selection by closing 2 contacts of 36-pin rear panel connector to ground pin. Contact is at 12 volts and short to ground will draw 12 mA.

Power: 115 or 230 V ac $\pm 10\%$, 50-400 Hz, 15 W.

Weight: Net, 27 lb (12,4 kg). Shipping, 34 lb (15,2 kg).

Dimensions: 5½ in. high, 16¾ in. wide, 18⅜ in. deep
(140 x 426 x 467 mm).

Price: Model 8743A, \$2,550.00.

Recommended Accessories:

11565A APC-7 Short: Price \$25.00.

11605A Flexible Arm

11605A FLEXIBLE ARM



Function: Mounts on front of 8743A; connects to device under test. Rotary air lines and rotary joints connect any two-port geometry.

Impedance: 50 ohms nominal. Reflection coefficient of ports: ≤ 0.11 [1.25 SWR], dc - 12.4 GHz.

Connectors: APC-7.

Insertion Loss: Approximately 1.5 dB.

Weight: Net, 4 lb (1,8 kg). Shipping, 6 lb (2,7 kg).

Length: 10.1 in. (256,5 mm) closed, 25.5 in. (647,7 mm) extended.

Price: Model 11605A, \$700.00.

INDIVIDUAL INSTRUMENT SPECIFICATIONS

8745A S-PARAMETER TEST UNIT



Function: Wideband RF power splitter and reflectometer with calibrated line stretcher. Pushbutton operated for either transmission or reflection measurements with Network Analyzer.

Frequency Range: 100 MHz to 2 GHz. Can be used below 100 MHz since coupler directivity remains above 36 dB and insertion loss to reference and test channel outputs increases ≈ 6 dB/octave.

Impedance: 50 ohms nominal.

Source Reflection Coefficient:¹ ≤ 0.057 (< 1.12 SWR), 0.11 - 2.0 GHz.

Termination Reflection Coefficient:²

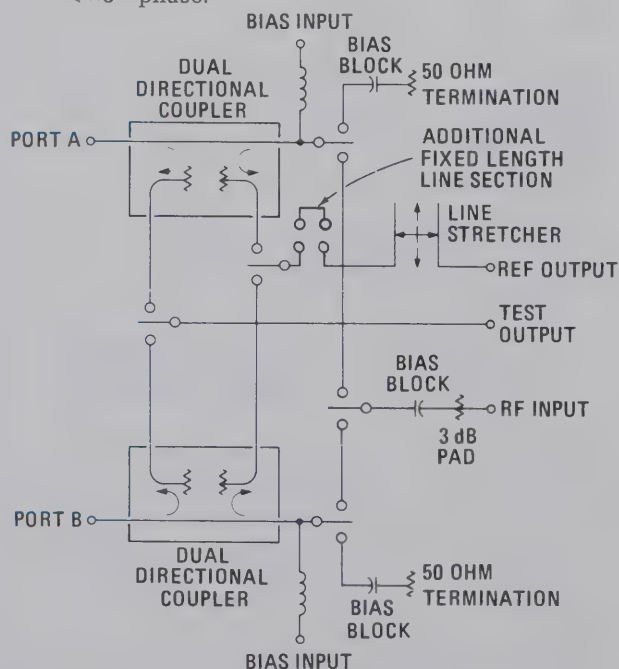
Transmission: < 0.10 (< 1.22 SWR), 100 - 200 MHz;
 < 0.063 (< 1.13 SWR), 200 - 2000 MHz.

Reflection: < 0.10 (< 1.22 SWR), 100 - 200 MHz;
 < 0.063 (< 1.13 SWR), 200 - 2000 MHz.

Directivity: Below 1 GHz, ≥ 36 dB; 1 - 2 GHz, ≥ 32 dB.

Frequency Response: (Including 8411A frequency converter.)

Transmission: Typically ± 0.35 dB amplitude
 $\pm 5^\circ$ phase.



8745A RF Schematic

¹ Equivalent source reflection coefficient when used with Network Analyzer.

² Reflection coefficient of port that connects to the 11605A flexible arm.

Reflection: Typically $< \pm 0.06$ magnitude $< \pm 5^\circ$ phase as read on the 8414A with a short on the test port.

Insertion Loss: From RF input to test device, 4 dB nominal. From RF input to reference channel output 23 dB nominal.

Maximum RF Power: 2 watts.

Reference Plane Extension: 0 to 15 cm for reflection; 0 to 30 cm for transmission; calibrated by digital dial indicator. Indicator is adjustable for initial calibration.

Connectors: RF Input, Type N female, stainless steel; all other connectors APC-7.

Outputs to 8411A: Mates with APC-7 precision connectors.

Option 001, Type N female (for use with 8405A Vector Voltmeter).

Remote Programming: Remote s parameter selection by closing 2 contacts of 36-pin rear panel connector to ground pin. Contact is at 12 volts and short to ground will draw 12 mA.

Transistor Biasing: Bias and bias sensing connections are made to the biasing networks built into the 8745A via the 36-pin rear panel connector.

Maximum Bias: 100 V dc; 1.0 amp.

Power: 115 or 230 V ac $\pm 10\%$, 50 to 400 Hz, 40 watts.

Weight: Net, 34 $\frac{1}{4}$ lb (15.9 kg). Shipping, 40 lb (17.5 kg).

Dimensions: 5 $\frac{1}{2}$ x 16 $\frac{3}{4}$ x 25 $\frac{3}{4}$ in. (139 x 423 x 650 mm).

Price: Model 8745A, \$3,150.00.

Option 001 (Type N female connectors on outputs to 8411A). No additional charge.

Recommended Accessory: 11604A Universal Extension.

11604A UNIVERSAL EXTENSION



Function: Mounts on front of 8745A; connects to device under test. Rotary air lines and rotary joints connect to any two-port geometry.

Frequency Range: dc to 2 GHz.

Impedance: 50 ohms nominal, reflection coefficient 0.035 (1.07 SWR).

Weight: Net, 4 lb (1.8 kg). Shipping, 5 lb (2.2 kg).

Dimensions: 10 $\frac{1}{2}$ x 5 x 1 $\frac{1}{4}$ in. (267 x 127 x 31.6 mm).

Price: Model 11604A, \$850.00. (Includes rear panel coaxial length HP Part No. 11604-20021.)

INDIVIDUAL INSTRUMENT SPECIFICATIONS

TRANSDUCER UNITS

8740A TRANSMISSION TEST UNIT



Function: RF power splitter and calibrated line stretcher for transmission measurement with Network Analyzer.

Frequency Range: dc to 12.4 GHz.

Amplitude Frequency Response: [Including frequency response of 8411A Converter.] 0.1 to 8 GHz, ± 0.5 dB (typical); 8 to 12.4 GHz, ± 0.7 dB (typical).

Phase Frequency Response: [Including frequency response of 8411A Converter.] 0.1 to 8 GHz, $\pm 3^\circ$ (typical); 8 to 12.4 GHz, $\pm 5^\circ$ (typical).

Output Impedance: 50 ohms nominal, reflection coefficient 0.07 (1.15 SWR), dc to 7 GHz; 0.11 (1.25 SWR), 7.0 to 12.4 GHz.

Maximum RF Input Power: 1 watt.

Insertion Loss: 17 dB nominal.

Connectors: RF Input, Type N female, stainless steel; output, APC-7.

Reference Plane Extension:

Electrical, 0 to 30 centimeters.

Mechanical, 0 to 10 centimeters.

Both extensions calibrated by digital indicators.

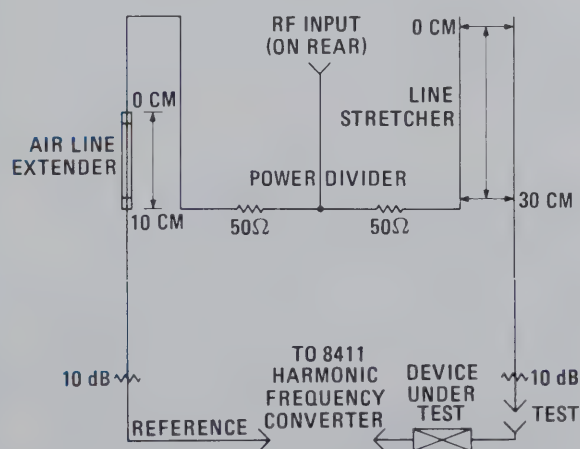
Power: Passive, no primary power required.

Weight: Net, 16 lb (7,1 kg). Shipping, 21 lb (9,4 kg).

Dimensions: 6 in. high, $16\frac{3}{16}$ in. deep, $7\frac{7}{32}$ in. wide (15,2 x 41 x 18,6 cm), excluding knobs and connectors.

Price: Model 8740A, \$1,500.00.

Recommended Accessory: 11587A Accessory Kit:
Price, \$875.00.



8740A RF Schematic

8741A & 8742A REFLECTION TEST UNITS



Function: Wideband reflectometer, phase-balanced for swept or single frequency impedance tests with 8410A. Calibrated adjustable reference plane.

Frequency Range: 0.11 - 2.0 GHz (8741A); 2.0 - 12.4 GHz (8742A).

Frequency Response: [Including Frequency Response of 8411A Converter.] Typically $< \pm 0.1$ magnitude and $< \pm 5^\circ$ phase as read on 8414A polar display with short on unknown port.

Impedance: 50 ohms nominal.

Directivity: ≥ 36 dB 0.11 - 1 GHz, ≥ 32 dB 1 - 2 GHz (8741A); ≥ 30 dB 2 - 12.4 GHz (8742A).

Connectors: RF Input, Type N female, stainless steel; all other connectors APC-7.

Reference Plane Extension: 0 - 15 cm (8741A), 0 - 16.5 cm (8742A), calibrated by digital dial indicator for initial calibration.

Accessories Furnished: 11565A, APC-7 short for reflectometer calibration.

Power: Passive, no primary power required.

Weight (8741A and 8742A): Net, 15 lb (6,7 kg). Shipping, 20 lb (8,9 kg).

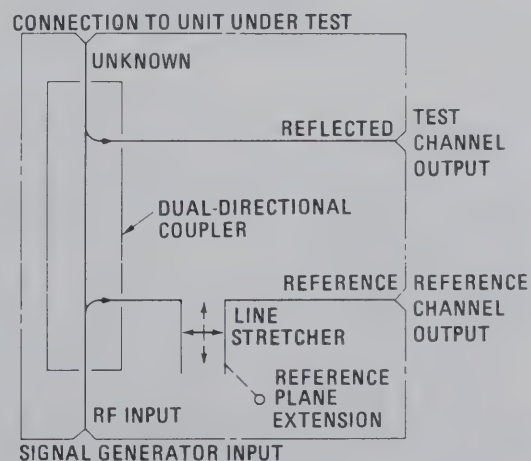
Dimensions: 6 in. high, $16\frac{3}{16}$ in. deep, $7\frac{7}{32}$ in. wide (15,2 x 41 x 18,6 cm), excluding connectors and knobs.

Price:

Model 8741A, \$1,600.00.

Model 8742A, \$1,700.00.

Recommended Accessory: 11587A Accessory Kit:
Price, \$875.00.

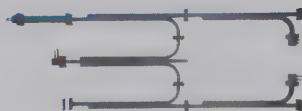


8741A/8742A RF Schematic

INDIVIDUAL INSTRUMENT SPECIFICATIONS

TRANSDUCER UNITS

8747A WAVEGUIDE REFLECTION/ TRANSMISSION TEST UNIT



Function: Waveguide setup for measuring reflection and transmission parameters of waveguide devices with the Network Analyzer.

	X8747A (WR-90)	P8747A ⁴ (WR-62)
Frequency Range	8.2 to 12.4 GHz	12.4 to 18 GHz
Directivity	>40 dB	>40 dB
Source Reflection Coefficient ¹	<0.12	<0.12
Termination Reflection Coefficient ²	<0.08	<0.1
Reflectometer Source Match ³	<0.05	<0.05
Frequency Response: (with 8411A)	±1 dB, ±5° (typical)	±3 dB, ±10° (typical)
Insertion Loss:		
RF Input to Refl. Test Port	~5 dB	~5 dB
RF Input to Trans. Test Port	~15 dB	~15 dB
RF Input to 8411A Inputs	~25 dB	~25 dB
Reference Plane Extension	10 cm	10 cm
Weight	Net 11 lb (4.95 kg) Shipping 16 lb (7.2 kg)	7 lb (3.15 kg) 11 lb (4.95 kg)
Dimensions	14 x 41 in. (350 x 1030 mm)	12 x 33 in. (300 x 830 mm)
Price	\$1,800.00	\$1,800.00

¹ Source Reflection Coefficient: Reflection coefficient of the port used to supply incident signal to the device under test when transmission measurement is being made.

² Termination Reflection Coefficient: Reflection coefficient of port connected to output of test device when transmission measurement is being made.

³ Reflectometer Source Match: Equivalent source reflection coefficient when reflection measurement is being made.

⁴ Special 8411A is recommended for use in P band. See additional information at end of data sheet.

AUXILIARY S-PARAMETER INSTRUMENTS

11600B/11602B TRANSISTOR FIXTURES



Function: Holds devices for s-parameter measurements in a 50-ohm, coax circuit. Either fixture provides common emitter, base, and collector for bi-polars, and common source, gate, and drain for FET's. Other devices also fit the fixtures (tunnel diodes, diodes, etc.).

Transistor Base Patterns:

Model 11600B: Accepts TO-18/TO-72 packages. Will also accept any 3 or 4 lead package with leads that lie on a 0.1 inch circle and whose diameters are 0.016 to 0.019 inch.

Model 11602B: Accepts TO-5/TO-12 packages. Will also accept any 3 or 4 lead package with leads that lie on a 0.2 inch circle and whose diameters are 0.016 to 0.019 inch.

CALIBRATION REFERENCES

Function: Two calibration references:

1. Short-circuit termination
2. 50-ohm through section, are included for calibration of the transistor fixtures.

11600B AND 11602B SPECIFICATIONS

Lead Lengths: Up to 1.5 inches long.

Frequency Ranges: dc to 2 GHz nominal.

Impedance: 50-ohm nominal.

VSWR:

11600B: <1.1 from dc to 2.0 GHz.

11602B: <1.15 from dc to 2.0 GHz.

Connectors: APC-7 precision connectors.

Option 001: Precision Type N connectors.

Maximum Power: 10 W including RF signals.

Dimensions: 4 5/8 x 6 x 1/2 in. (119 x 152 x 38 mm).

Weight. Net, 36 oz (1.1 kg). Shipping, 4 lb (1.8 kg).

Price:

Model 11600B: \$600.00.

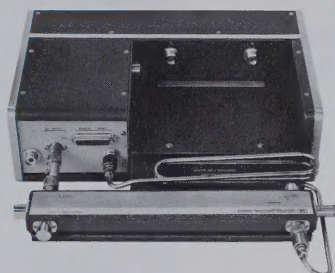
Model 11602B: \$600.00.

Option 001: Precision Type N connectors, less \$30.00.

INDIVIDUAL INSTRUMENT SPECIFICATIONS

AUXILIARY S-PARAMETER INSTRUMENTS

11607A SMALL SIGNAL ADAPTER



Model 11607A Installed
on Model 8745A

Function: To be used with Hewlett-Packard Model 8745A S-Parameter Test Set. Permits measurements with Model 8410A Network Analyzer with incident signal levels in the -20 to -40 dBm range.

Frequency Range: 0.11 to 2 GHz.

Reflection Coefficient (SWR):

RF Input: 0.11 (1.25).

Reference Output: 0.11 (1.25).

RF Output: (Model 8745A RF Input) 0.09 (1.2).

RF Input Power (maximum):

2 watts average.

50 watts peak.

Directivity: ≥ 26 dB.

Connectors:

RF Input: Type N female, stainless steel.

Reference Channel Output: APC-7 (type) mates with APC-7¹ connectors.

Output: Type N male, stainless steel.

Dimensions in Inches (mm):

16 $\frac{1}{4}$ (413) x 9 (229) x 2 $\frac{3}{8}$ (60) behind 8745A.

16 $\frac{1}{4}$ (413) x 9 $\frac{5}{8}$ (244) x 2 $\frac{3}{8}$ (60) overall.

Weight: Net, 4 $\frac{5}{8}$ lb (2 kg). Shipping, 10 lb (4.65 kg).

Price: \$600.00.

TYPICAL SUPPLEMENTAL PERFORMANCE CHARACTERISTICS¹

Frequency Response:

Amplitude: ± 0.7 dB.

Phase: $\pm 5^\circ$.

Transistor Drive Level:

-20 dBm to -40 dBm (with 20 dB attenuator).

-40 dBm to -60 dBm (with 40 dB attenuator).

¹ When used with an 8745A and an 8410A Network Analyzer System.

8717A TRANSISTOR BIAS SUPPLY



Function: Operates in two modes, normal and independent. Normal is used to bias transistors; independent switches the two internal supplies into a voltage and an independent current supply.

Operation: The 8717A is a companion unit to the 11600B/11602B Transistor Fixtures. This bias supply, designed to be used with the 8745A S-Parameter Test Set, eliminates the possibility of oscillations in the transistor under test. The front panel controls quickly establish bias conditions for all transistor configurations. This eliminates the need for wiring changes for each new configuration; two meters independently measure one of the currents on any of the three leads of the transistor under test. Transistors are protected by an emitter current limit shut-down circuit which removes biasing when the preset limit is exceeded.

Instrument Type: Transistor bias supply with two modes of operation, NORMAL and INDEPENDENT. NORMAL is used to bias transistors. INDEPENDENT switches the two internal supplies into a voltage supply and an independent current supply.

Option 001: Digital/analog converter for remote programming capability. Switching speed ≤ 40 ms (typical).

Power: 115 or 230 V $\pm 10\%$, 50 to 400 Hz, 65 watts.

Dimensions: 16 $\frac{3}{4}$ x 3 $\frac{3}{8}$ x 13 $\frac{1}{2}$ in. (425 x 86 x 336 mm).

Weight: Net, 17 $\frac{3}{4}$ lb (8.0 kg). Shipping, 25 lb (11.3 kg).

Price: \$1,450.00.

Option 001: Programmable D/A converter, add \$550.00.

(See next page)

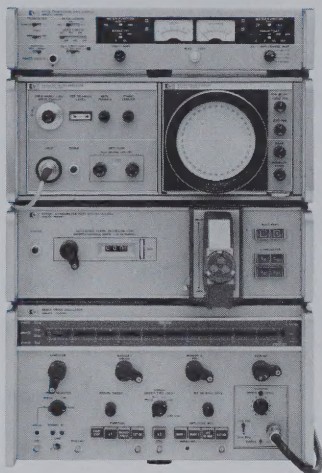
INDIVIDUAL INSTRUMENT SPECIFICATIONS

AUXILIARY S-PARAMETER INSTRUMENTS

8717A TRANSISTOR BIAS SUPPLY (Cont'd)

	MANUAL		PROGRAMMED	
	NORMAL	INDEPENDENT	NORMAL	INDEPENDENT
Outputs:	Continuously variable		Variable in 0.25 V steps	
DC Voltage	V_{CE} (V_{DS}) 0 - 31.75 V dc @ 500 mA (nominal) 0 - 31.75 V dc @ 500 mA (nominal)		Same as MANUAL	
DC Current	Continuously variable		Step = 3.13% full scale current range	
	4 ranges	3 ranges	4 ranges	3 ranges
	0.01 - 1 mA 0.1 - 10 mA 1.0 - 100 mA 10 - 500 mA	0.01 - 1 mA 0.1 - 10 mA 1.0 - 100 mA @ ± 10 V dc	0.0157 - 1 mA 0.157 - 10 mA 1.57 - 100 mA 15.7 - 1000 mA (500 mA max. output)	0.0157 - 1 mA 0.157 - 10 mA 1.57 - 100 mA @ ± 10 V dc
Voltage Accuracy	$\pm 4\%$ of meter full scale		$\pm (0.2 \text{ V dc} + 2\% \text{ of programmed value})$	
Current Accuracy	$\pm 4\%$ of meter full scale		$\pm (5 \mu\text{A} + 2\% \text{ of programmed value})$	
SUPPLEMENTAL PERFORMANCE CHARACTERISTICS				
Load Regulation: Constant Voltage	$\leq 0.2\% + 20 \text{ mV}$ when current varies from 0 to 500 mA (typical)			
Constant Current	$\leq 1.0\%$ when voltage varies from 0 to 10 V (for current ranges $\leq 100 \text{ mA}$) (typical)			
Line Regulation: Constant Voltage	$\leq 0.1\% + 30 \text{ mV}$ for 115 or 230 V $\pm 10\%$			
Constant Current	$\leq 0.001\% + 1 \mu\text{A}$ for 115 or 250 V $\pm 10\%$			
Ripple: Constant Voltage	$\leq 20 \text{ mV}$			
Constant Current	$\leq 100 \mu\text{A}$			
Transient Recovery: Voltage	Recovery to within 1% of final value $\leq 500 \mu\text{s}$ (typical)			
Current	Recovery to within 1% of final value $\leq 20 \text{ ms}$ (typical)			

COMPLEMENTARY EQUIPMENT



8690B/8620A SWEEP OSCILLATORS

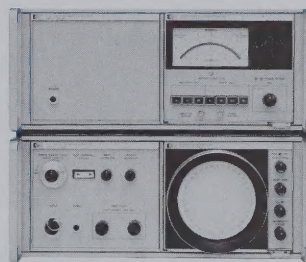
Function: As a key building block in complete microwave measurement systems, the HP 8620A and 8690B Sweep Oscillators are fully compatible with the HP 8410A Network Analyzer Systems. With the multiband capability of the 8620A and the broadband coverage of the Network Analyzer, design and test of components and systems over wide frequency ranges can be accomplished without time consuming changes to test setups. For applications requiring extreme frequency stability, the 8620A is fully compatible with HP phase-locking instrumentation. See the respective data sheets for further information.

8418A AUXILIARY POWER SUPPLY

Function: The 8418A Power Supply Unit provides power for operation of the 8412A Phase-Magnitude Display, the 8413A Phase-Gain Indicator or the 8414A Polar Display Unit. Used in conjunction with the 8410A Opt 005 Network Analyzer, it provides the capability of viewing amplitude and phase readout in both rectangular and polar coordinates simultaneously.

Weight: Net, 25 lb [11,2 kg]. Shipping, 44 lb [19,7 kg].

Price: Model 8418A, \$500.00.



905A AND 911A SLIDING LOADS



HP Models 905A and 911A Coaxial Sliding Loads are movable, low-reflection loads for use in precision microwave measurements from 2 to 18 GHz. The 905A has interchangeable Type N and APC-7 Connectors. The 911A is equipped with SMA connectors. Both loads are ideal for use with the HP Network Analyzer to improve the accuracy of reflection coefficient measurements by calibrating out both phase and magnitude of the directivity signal. See the respective data sheets for further information.

Additional Information

RF Source Requirements

While the recommended Sweep Oscillators for 8410S Network Analyzer System are the HP 690 Series, the HP 8690B with 8690 series RF plug-ins or HP 8620A with 8630 series RF plug-ins, other sweep oscillators are usable, but usually with degraded performance. Critical specifications for best performance are as follows:

RF Output: +15 dBm to -6 dBm.

Signal Purity: Spurious signals should be at least 20 dB below the desired frequency sweep characteristics.

Sweep Characteristics: Swept signal sources should have uniform sweep rate that is variable between about 15 and 150 MHz per millisecond. RF blanking should not be used in order to keep the Network Analyzer in phase lock during retrace. An additional important requirement is a pause between sweeps. There should be at least a 3-millisecond pause at the start frequency prior to each sweep in order to allow the Network Analyzer to lock initially.

Sweep Reference Voltage Output: For fastest swept-frequency measurements, the signal source should furnish a voltage proportional to output frequency. This voltage enables the Network Analyzer to track at high sweep rates, and is required for down sweeping octaves and for sweeping wider frequency ranges than those marked on the **FREQ RANGE (GHz)** selector. Requirements for the voltage are positive polarity and range of 0 to 40 volts per frequency octave with the lowest voltage corresponding to the lowest frequency. Hewlett-Packard 8620-, 690-, and 8690-Series Sweep Oscillators furnish frequency-related voltage that is fully compatible with the Network Analyzer.

Extended Frequency Range

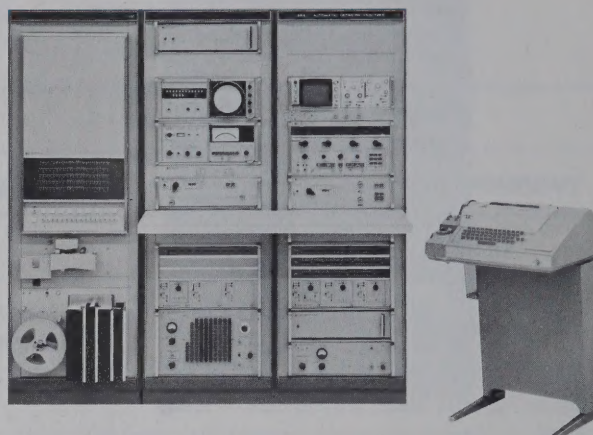
The Network Analyzer is built and tested to operate from 0.1 to 12.4 GHz. The frequency range is limited by the harmonic frequency converter and the directional couplers used for signal separation.

The Harmonic Frequency Converter typically works well as low as 50 MHz; however, increase in coupling factor in the S-Parameter Test Set requires an increase of RF power of about 6 dB.

From 12.4 GHz to 18.0 GHz measurements can be made with the P8747A Waveguide Reflection-Transmission Test Unit.

For best performance outside of the normal frequency range, a special 8411A can be provided on request.

Hewlett-Packard Automatic Network Analyzer



A Typical 8542A Automatic Network Analyzer

All of the advantages available with the HP 8410S Network Analyzer Systems have been coupled to the speed, versatility, and accuracy of an HP Computer in the HP Automatic Network Analyzer. This system provides:

Complete Device Characterization:

- Measures linear one, two-port parameters from 0.11 to 12.4 GHz.
- Generates both temporary and permanent data records.
- Can compare measured data against preset limits.

High Accuracy:


- Approaches routine standards lab precision.
- Capable of transfer measurements from NBS calibrated standards.

Speed and Flexibility:

- Takes hundreds of readings per minute.
- Tests a wide variety of devices.
- Adapts to specialized applications via easy-to-use programming languages.
- Displays data in most useful format.

For more information concerning Microwave Network Analysis contact the HP sales office nearest you for the latest Application Notes and HP Journal articles. Application Notes which are now available are: AN-92 which covers basic transmission and reflection measurements as well as several special purpose applications; AN-95 is an accumulation of several articles which discuss design techniques with s parameters; AN-110 dis-

cusses antenna/radome boresight measurements; AN-117-1 serves as the Basic Handbook for 8410S operation. January 1969 HP Journal discusses the 8745A S-Parameter Test Set, 8743A Reflection/Transmission Test Unit and the broadband passive components which made them possible. Also included is an article on transistor s parameter measurements.

HEWLETT  PACKARD